GEOTHERMAL PROSPECT

GABBS VALLEY

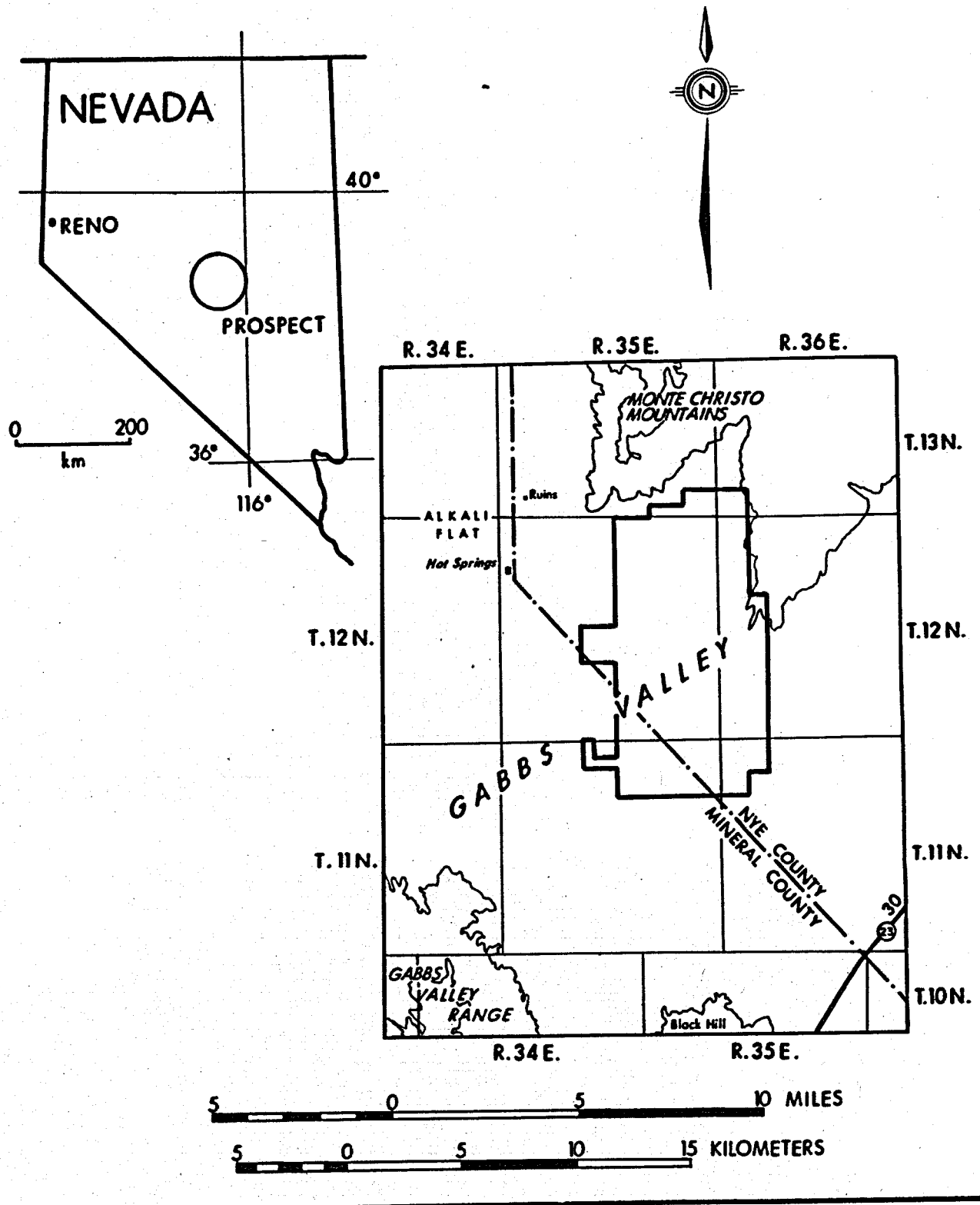
NEVADA

AL-AQUITAINE EXPLORATION LTD.

DISCLAIMER

TABLE OF CONTENTS

LIST OF MAPS & FIGURES



GABBS VALLEY GEOTHERMAL PROSPECT

NYE & MINERAL COUNTIES, NEVADA

GEOGRAPHICAL LOCATION MAP

MAP No. 1

GEOTHERMAL PROSPECT

GABBS VALLEY

NEVADA

GEOGRAPHICAL SETTING

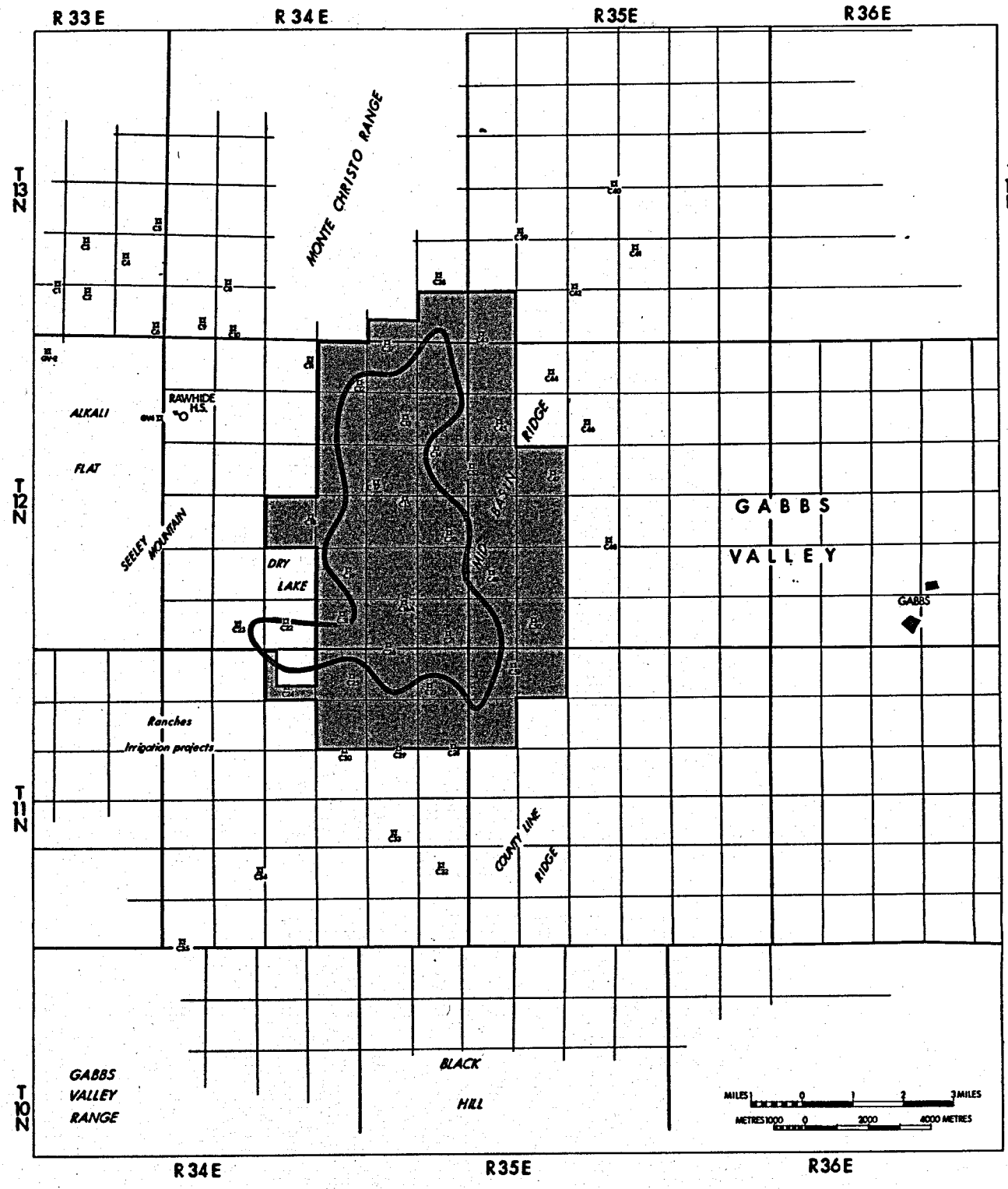
The Gabbs Valley Geothermal Prospect is located in Nye and Mineral counties in Western Nevada (Map 1). The climate is arid with a mean annual precipitation of only 3½ inches. Scarce sagebrush and other desert shrubs are the only plants to grow in the prospect area which is totally devoid of trees.

The closest town is Gabbs, 10 miles east of the centre of the prospect (Map 2). It is a mining town wholly dependent upon a nearby magnesite mine. Reno lies about 150 miles to the northwest and could be one potential market for the energy provided by a successful development of the prospect, in addition to the California market.

GEOLOGY (Map 3)

The Gabbs Valley prospect is situated in the Basin and Range Province. It is within a large basin filled with Quaternary and possibly older beds of alluvium, playa deposits, conglomerates, lacustrine beds and diatomites, with clay material constituting a large part of these deposits. This basin fill ranges from 0 to 10,000 feet in thickness.

The surrounding ranges are essentially composed of Tertiary volcanic rocks with minor amounts of Cretaceous plutonic rocks and Jurassic sedimentary beds.



AL-AQUITAINE & KISSINGER LEASES

HEAT ANOMALY

GABBS VALLEY GEOTHERMAL PROSPECT

NYE & MINERAL COUNTIES, NEVADA

LEASEHOLD ACREAGE

MAP No. 2

The main geological components of the stratigraphic column shown on Map 3 are as follows:

QFA - is an unconsolidated fanglomerate made up of gravels, pebbles and boulders of volcanic rocks. It occurs on the crest of the Mid-Basin Ridge which trends NNE-SSW through the centre of Gabbs Valley.

QTS - are lacustrine beds consisting predominantly of diatomite with interbeds of calcareous micro-conglomerate, silty limestone and clay.

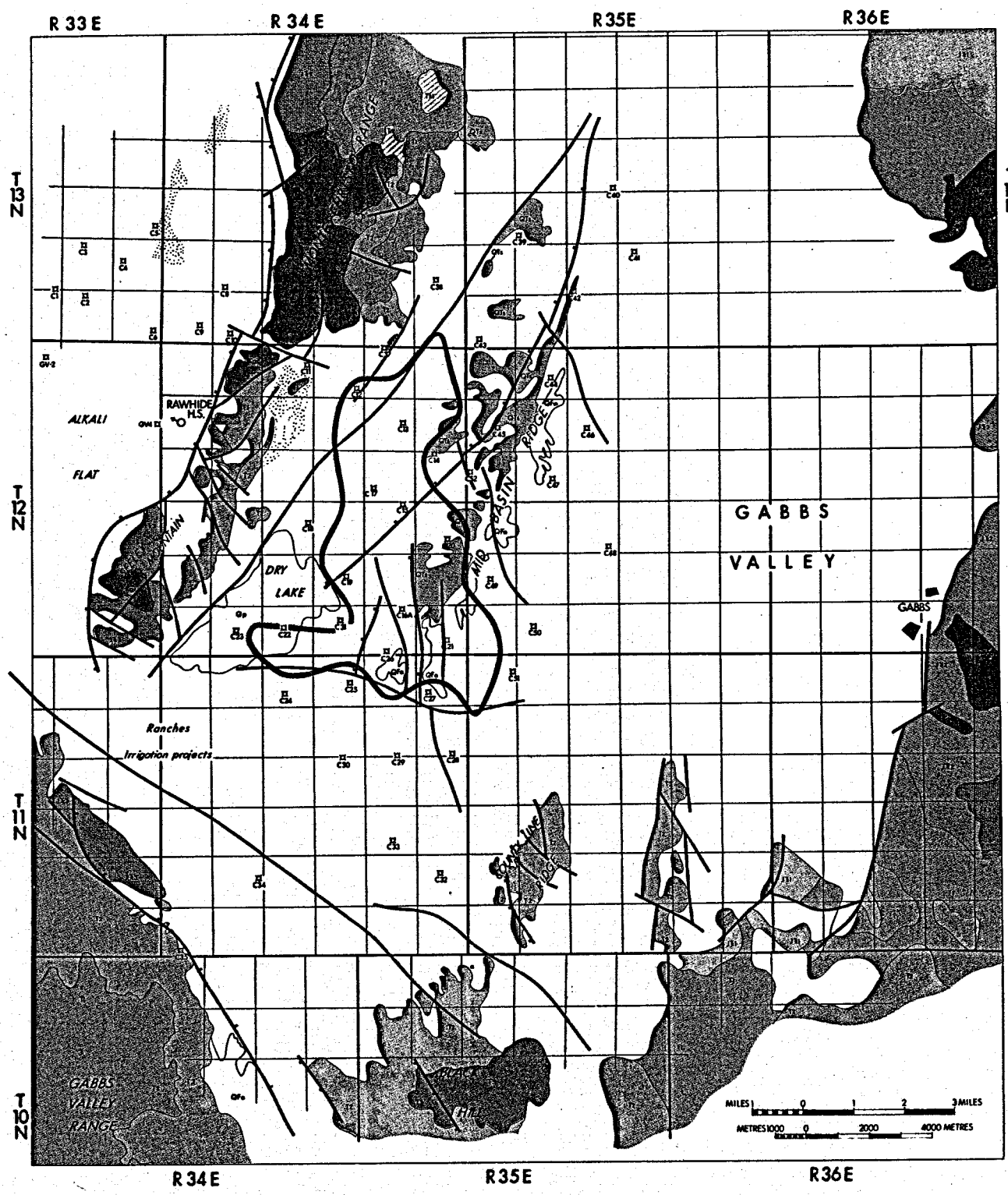
T3 - is apparently the most recent of the volcanic extrusives in the area. These volcanics consist of andesite with a characteristic brownish colour due to weathering. Potassium/argon analysis has given an age of 10 million years (Upper Miocene) for these rocks.

T2 - is a thick complex of basic Tertiary volcanic rocks, consisting predominantly of andesite, with lesser amounts of basalt, trachyte, latite and breccia. It forms the framework of the Gabbs Valley Range, of the Black Hills and of part of the Monte Cristo Range.

T1 - is a complex of Tertiary acid volcanics mostly represented by rhyolite and rhyolite tuffs. These tuffs are very prominent on the landscape due to their white colouring and bright pink and red weathering.

Kgr - refers to plutonic rocks of Cretaceous age consisting of quartz monzonite, quartz diorite and granodiorite. This batholith now forms some of the highest mountains in the area and has been dated at 89 million years.

JT3 - is a sedimentary sequence of Jurassic age consisting of mudstone, siltstone and graywackes alternating with rare volcanic flows. The weathering colour is dark grey to brown.



QUATERNARY

- Q Surficial cover
- Qp Playa deposit
- QFa Fanglomerate
- QTs Lacustrine beds

TERTIARY

- T3 Andesite flows
- T2 Basic volcanic rocks
- T1 Acid volcanic unit
- Th Rhyolite, weathered white

TEMPERATURE WELL

HEAT ANOMALY

CRETACEOUS

- Kgr Monte Christo pluton

JURASSIC

- JE3 Arenaceous and argillaceous sedimentary rocks
- JE2 Limestone with minor dolomite and shale
- JE1 Volcanic derived sedimentary rocks

GABBS VALLEY GEOTHERMAL PROSPECT

NYE & MINERAL COUNTIES, NEVADA

GEOLOGICAL MAP

MAP No. 3

TECTONICS

The Gabbs Valley Geothermal Prospect is located at the intersection of two tectonic trends. To the north, the Basin and Range Province is controlled by NNE trending faults. In the south, below a well-defined hinge line which can easily be traced across western Nevada into northern California, the predominant direction of faulting is orientated to the northwest, parallel to the Sierra Nevada trend. This hinge line corresponds to a shear zone with strike slip displacement demonstrated southeast of Gabbs (D.R. Shaw, Geol. Soc. Am. Bull., Dec. 1965). It is believed that this hinge line coincides with an anomalously thin crust and a high regional geothermal gradient. This provides favourable background conditions for the development of local, geologically controlled heat anomalies similar to the one found in the prospect area.

Aerial photograph interpretation, field mapping and geophysical studies all show that the whole region has been severely broken up by tectonism along these two major trends. A gravity profile, for example, running from the north of the Alkali Flat across the southern tip of the Monte Cristo Range demonstrates the presence of a NNE trending fault with significant vertical displacement (over 1,000 feet) along which the Rawhide Hot Spring is located.

It is believed that the heat anomaly discovered in the prospect area is directly related to an active NW trending fault zone. This fault zone, which is not exposed at the surface, was discovered and confirmed by various geophysical techniques.

TEMPERATURE GRADIENT SURVEY

The temperature gradient has been evaluated by three successive campaigns of shallow drilling, totalling 51 five hundred foot wells and one intermediate well at 1255 feet.

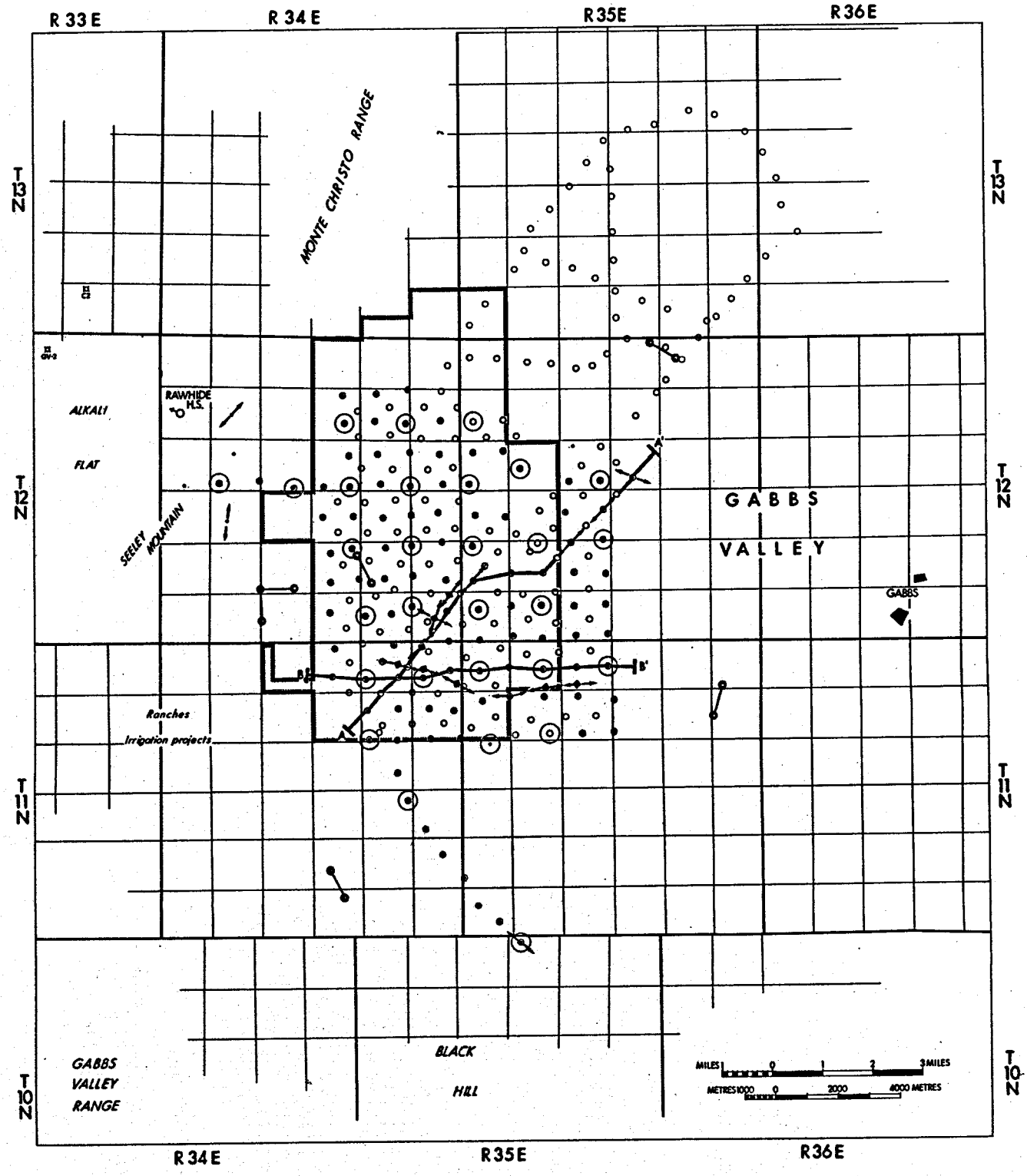
The first drilling program (holes C1 to C16) was undertaken in the spring of 1976 and resulted in the discovery of an outstanding heat anomaly (map 2). In the second phase (holes C17 to C36), twenty additional shallow tests were drilled in February and March 1977 to delineate the areal extent of the anomaly towards the south. At the same time C-16A was drilled to a total depth of 1255 feet to further study the very high heat anomaly discovered at well C-16, which is ten times the normal geothermal gradient.

The final stage of shallow drilling, in the spring of 1977, was undertaken to study the possible extension of the heat anomaly to the north. As a result of this 15 well program the areal extent of the heat anomaly discovered in the first round of drilling, has been completely defined.

The heat anomaly outlined on map (2) is for values greater than three times the normal geothermal gradient of 1°C per 30 m.

GEOPHYSICAL SURVEYS (Map 4)

Three separate geophysical programs were undertaken in order to define the basement structure, the nature of the tectonics, to investigate potential geothermal reservoirs and to determine the presence of active faulting. From the interpretation of these geophysical surveys it has been possible to locate a deep 6,000 ft. test to intercept an active basement fault zone.



CURRENT ELECTRODE FOR TIME-DOMAIN ELECTROMAGNETIC MEASUREMENTS SHOWING SOURCE NUMBER.

TIME-DOMAIN ELECTROMAGNETIC RECEIVER STATION

SCHLUMBERGER SOUNDING SHOWING CENTER AND DIRECTION OF AB SPREAD

TENSOR MAGNETOTELLURIC STATION

ELECTRICAL CROSS SECTION

AL-AQUITAINE & KISSINGER LEASES

GABBS VALLEY GEOTHERMAL PROSPECT

NYE & MINERAL COUNTIES, NEVADA

1978 GRAVITY, MAGNETIC AND ELECTRIC SURVEY LOCATIONS

MAP No. 4

Gravity Surveys

In the preliminary survey of 1974 gravity profiles were recorded along two northwest/southeast lines across Gabbs Valley and Alkali Flats. In early 1977 gravity data were acquired at 434 stations along 3 profiles covering 35 line miles. The final gravity survey was undertaken in late 1977 on a 500 metre grid at 253 stations.

From the gravity data acquired in the above three surveys it was possible to prepare a detailed map of the structure of the top of the basement in the prospect area.

Electric Surveys

Magnetic, magnetotelluric, TDEM and Schlumberger soundings were undertaken concurrently with the gravity surveys.

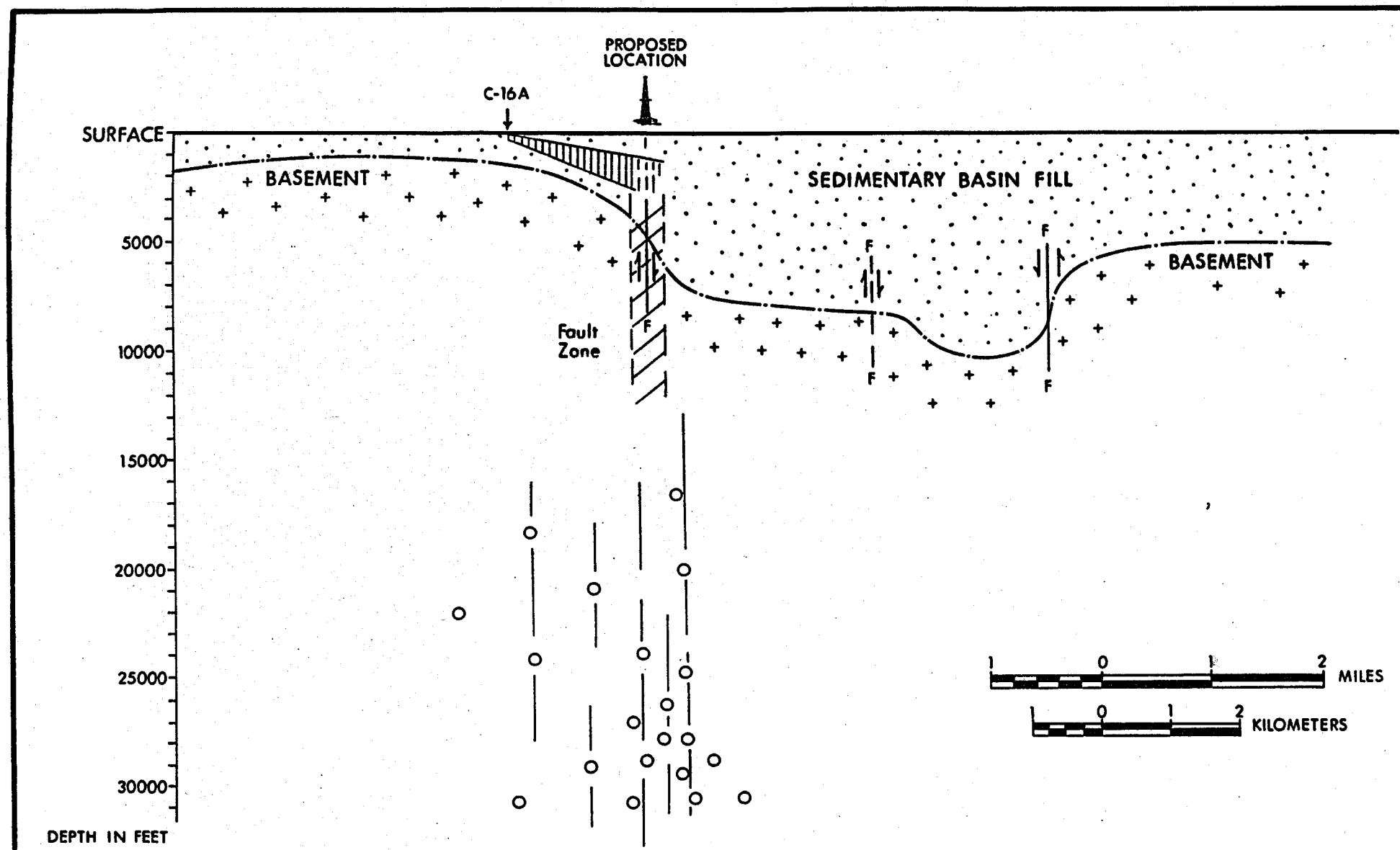
The magnetic data confirms the structural nose on the west side of the prospect and the northwest trending cross fault which was shown to be active from the micro-seismic survey.

The Schlumberger soundings undertaken along profiles $A-A^1$ and $B-B^1$ in 1977 indicated a low resistivity layer which has been interpreted as an impervious clay horizon (Fig. 1).

A comparison of the TDEM depth to basement map, prepared from data collected at 90 stations, compares extremely well with the depth to basement map produced from the gravity surveys and provides a vindication of the more detailed gravity data interpretation.

Micro-Seismic Surveys

The passive seismic data revealed the presence of a significant northwest trending active fault zone. This fault zone lies on and immediately to the east of the heat anomaly discovered in the shallow drilling program. It is believed that there is a direct relationship



O Micro seismic hypocentres

Basement from gravity data

GABBS VALLEY GEOTHERMAL PROSPECT

NYE & MINERAL COUNTIES, NEVADA

SOUTHWEST-NORTHEAST CROSS-SECTION

FIGURE 1

between the shallow heat anomaly and this active fault zone. Furthermore, the clay horizon indicated by the electric surveys (Fig. 1) could have acted to divert the migrating, geothermally heated fluids from the fault zone to the area of the highest measured shallow heat anomaly.

GEOCHEMICAL PROSPECTING

Due to its high vapour pressure, mercury is believed to become very mobile in the vicinity of geothermal cells and that overlying sediments and soils can become enriched in mercury.

A mercury study was undertaken in 1976 of the regolith in the Gabbs Valley area using a one mile spacing. The highest values (over 200 ppb as opposed to a regional background of 25 ppb) were found within the heat anomaly. The other area with a high mercury content (also over 200 ppb) was found in the immediate vicinity of the Rawhide Hot Springs.

HYDROGEOLOGY

Although it is evident that two water regimes, hot and cold, exist in the Gabbs Valley the frequent contact and intermixing of these two regimes have resulted in a complex hydrogeological system. Moreover, the heterogenity of the basin fill further complicates this system.

At shallow depths and at the surface both cold and hot water bodies are present. Southwest of the heat anomaly in the Dry Lake area, cold water is pumped at a high rate for irrigation purposes. The town of Gabbs pumps water at 56-68°C from various depths ranging from 325' to 625'.

Hot fluids migrating to the surface at the Rawhide Hot Springs are mixed below the surface with cooler water at shallow depths. The spring flows at a temperature of 52°C. The Na/K/Ca method (Fournier and Truesdell, 1973) gives an in-depth temperature of at least 164°C. The discrepancy between the surface temperature and that given by the chemical thermometer suggests, a mixing of hot and cold water, the latter coming from the cold artesian body known to the north. It is reasonable to anticipate, therefore, that temperatures of at least 180°C will be encountered in any deep reservoir found in Gabbs Valley.

RESERVOIR ROCKS

The primary reservoir objective is expected to be fracture porosity developed in and around an active fault zone within the basement rocks which will be encountered at a depth of approximately 5,000 feet (Fig. 1). It is also expected that some permeability and porosity will be developed in coarse clastic sediments which may immediately overly the basement. Such coarse clastics are encountered near the Red Rock Canyon in the Gabbs Valley Range overlying the basement.

CONCLUSION

The exhaustive geophysical and geological studies carried out in Gabbs Valley have all confirmed the presence of an outstanding geothermal prospect. Based on these studies, the location of a 6,000 foot test has been selected which should evaluate the potential geothermal resources of Gabbs Valley.